

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11)

EP 0 944 438 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
19.09.2001 Bulletin 2001/38

(51) Int Cl.7: **B05C 11/04**

(86) International application number:
PCT/SE97/02110

(21) Application number: **97950561.7**

(87) International publication number:
WO 98/26877 (25.06.1998 Gazette 1998/25)

(22) Date of filing: **16.12.1997**

(54) **COATING BLADE**

BESCHICHTUNGSKLINGE

LAME DE REVETEMENT

(84) Designated Contracting States:
AT BE CH DE DK ES FI FR GB IE IT LI NL PT

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(43) Date of publication of application:
29.09.1999 Bulletin 1999/39

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(56) References cited:
EP-A- 0 505 020 **WO-A-88/10155**

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Description

[0001] The present invention relates to a coating blade for applying coating material onto a travelling web, particularly coating liquid or paste onto a travelling paper web.

5 [0002] The traditional blade coating technology is based on the fact that the blade can deflect, i.e. that the blade in its cross-direction will be subject to deflection when the blade by one longitudinal edge thereof engages a travelling web. Contrary hereto Swedish patent 468 344 discloses a technology where the blade rather than being deflected has a movable attachment enabling movement of the blade towards and away from the travelling web. By using this technology it is possible to use coating blades which essentially have no bending capacity.

10 [0003] Since the primary function of the coating blade is to even and remove excess of a coating liquid containing hard particles, for example titanium dioxide, calcium carbonate and the like, the edge section of the blade engaging the travelling web will be subject to continuous wear. Such wear can be caused also by particles found in the paper web proper. As soon as the blade has reached a certain degree of wear it has to be replaced. Such replacement of blade involves high costs, on the one hand caused by the cost of the blade per se, on the other hand also and essentially by the production interruption caused by the change of blade.

15 [0004] An important property of coating blades is thus that the resistance to wear or abrasion is as high as possible. Since the blades which are used in the traditional blade coating techniques also shall have springing properties which to some extent result in a lower resistance to wear the blade quality becomes a compromise between spring properties and wear resistance.

20 [0005] In addition to the fact that the wear resistance of the blades is dependent on the material of the blade it is also known to coat the engagement surface of the blade with wear-resistant materials, for example ceramic materials or chromium. In view of the fact that such wear resistant layers shall be applied to elongate and thin materials, often steel bands, limitations in production will arise resulting in high production costs.

25 [0006] The present invention has for its main object to provide a coating blade of improved resistance to wear. Another object of the invention is to provide coating blades which can be manufactured at a low cost.

[0007] Yet another object of the invention is to provide blades which give advantages in a quality with regard to the coated layer. For these and other objects which will be clear from the following disclosure there is provided by the present invention coating blades for applying a coating material onto a travelling web. Although the invention is not restricted hereto it will in the following be described particularly in connection with the application of a coating liquid 30 onto a travelling paper web. The coating blade according to the invention includes a band of steel or other form-stable material which, along the edge section intended to engage the web, is provided with a wear-resistant coating. In accordance with the present invention it has been surprisingly found that if said coating is constituted by a material of a relatively low hardness, namely a hardness of about 10 to about 100 measured in accordance with Shore A, substantial advantages are gained in connection with the use of the coating blade.

35 [0008] The fact that the use of a coating blade having a coating of a relatively soft material resulted in a high wear resistance in combination with important operational advantages was completely surprising to the skilled artisan. As acknowledged in the conventional art one has looked for coating with hard materials, for example ceramics, metals or the like, for the purpose of obtaining a high wear resistance, and the relatively complicated techniques that have to be used for the application of this type of hard coatings has involved high production costs and thereby an undesired high price on the final product.

40 [0009] In connection with the present invention it is preferred that the coating applied to the coating blade has a hardness according to Shore A of about 30 to about 80, particularly about 40 to about 70. It is particularly preferred that the hardness according to Shore A lies within the range of about 50 to 60.

45 [0010] The surprising observation on which the present invention is founded, namely the possibility of using a relatively soft material as a coating, means that said coating material can be constituted by an organic polymer. Examples of useful polymers are polyurethanes, styrene-butadiene polymers, i.e. polymers of rubber type, and polyolephins.

[0011] A particularly preferred type of polymer is polyurethanes, the building stones of which in a conventional manner are constituted by polyols and diisocyanates. Usual diisocyanates for polyurethane systems are toluene diisocyanate, diphenylmethane diisocyanate and naphthalene diisocyanate. Also less common diisocyanates are available, such as 50 hexamethylene diisocyanate and isoforon diisocyanate. Polyurethanes are available for example as esterurethanes, etherurethanes and urethanes based on hydroxyl-terminated polybutadienes.

[0012] What type of pure polyurethane that is used in the present invention is not critical for the practical result as long as the hardness thereof lies within the ranges given above.

55 [0013] Experiments carried out while using the techniques according to the present invention have shown that the material results in high wear-resistance or abrasion-resistance but also other advantages, such as improved fiber coverage and operability, i.e. low failure frequency, have been recorded. The soft coating gives an improved compliance vis-à-vis the paper surface and thereby results in a lower puttying effect compared to traditional hard blades or blade coatings. The improved operability is probably due to the fact that the soft coating at the edge of the blade more easily

allows passage of the particles which are present in the paper web or in the coating paste in view of the fact that the soft material will be elastically deformed by the particle. Immediately after the passage of a particle the coating material then regains its starting position.

[0014] In view of the elasticity of the coating at the edge of the blade in engagement with the travelling web the blade edge also to some extent adapts to the contour of the paper surface which results in the desired effect that the coating layer covers the fibers of the base paper in a more even manner than in traditional coating using hard blades or blade coatings. This effect has been shown by extensive pilot experiments, where the result with regard to failure frequency and fiber coverage has been studied. In comparison with regard to rupture frequency the number of ruptures of the web occurring at the blade have been counted. The runs have been carried out at equal conditions with regard to base paper quality, running time, coating machine variables etc.

[0015] In the comparison with regard to fiber coverage the results have been studied by so called "burning tests" and colouring with an absorbing type of colour "kroda". The burning test is carried out by moisturing the coated paper surface with an about 10% ammonium chloride solution. This chemical results in darkening of the cellulose fibers when the paper is heated to about 300-400°C using a heat pistol or in a furnace. The white coating layer then appears in contrast against the dark substrate.

[0016] This test shows quite clearly how the coating layer has been distributed on the surface of the paper. The result of this comparison shows clearly that a polymer-coated blade in accordance with the invention results in a coating layer of a more even thickness as compared to a steel blade of conventional type which results in a flamy effect and thus greater amount of coating in the "valleys" of the paper surface and less coating on the "tops" of the paper surface.

[0017] The colouring test also shows the same result in that the colour is absorbed more on the sections where the coating layer is thinner. In view of the fact that the "valleys" of the paper surface are filled with the polymer coated blade as compared to the steel blade the surface irregularity will remain to some extent, whereas the positive effects of a reduced rupture frequency and improved fiber coverage is of a greater importance for many paper qualities.

[0018] The steel band used in the coating blade according to the present invention suitably has a thickness lying within the range about 0.2 to about 2 mm. The coating applied has a thickness which suitably lies within the range about 0.5 to about 5 mm.

[0019] In a particular embodiment of the coating blade according to the invention the coating covers said edge section and is provided with a chamfer for the enlargement of the surface of engagement of the coating on the travelling web.

[0020] The width of the coating as seen in a plane of the blade and perpendicular to its longitudinal direction is suitably about 5 to 25 mm, but this dimension is not particularly critical.

[0021] The invention also provides for an apparatus for the coating of a travelling web comprising means to carry and transport the web and two opposite coating blades extending across the web and engaging same with one edge section thereof, and which at the opposite edge are arranged in a blade holder for each blade with a fastening which allows movability to and fro the web of said edge section without essential deflection of the blade. In this apparatus according to the invention pressure means are arranged which at said edge section can bring each blade to engage the web forwarded between the opposite coating blades. The characterizing feature of the apparatus is that both coating blades are provided with a coating in accordance with the above description.

[0022] The apparatus according to the invention is particularly useful for the coating of thin paper qualities which are difficult to produce with low rupture frequencies. In the particular coating techniques where the web is fed between two opposite coating blades the use of blades having soft coatings is particularly advantageous. In the apparatus according to the present invention for two-sided coating of a travelling web by the use of juxtaposed coating blades pilot experiments have shown a substantially reduced rupture frequency. The method of using juxtaposed coating blades has previously found limited use in view of the fact that it easily results in web failure when using traditional hard blades or blade coatings. The web failures arise in view of the fact that lumps or particles in the paste and/or in the web often cannot pass the nip between the blades without being arrested thereby rupturing the web.

[0023] As examples in comparing tests between traditional steel blades and a steel blade which along the engaging edge section has been coated with a polymer consisting of a polyurethane based on diphenylmethane diisocyanate (MDI) with a hardness of about 60° Shore A and with otherwise similar conditions have shown that traditional blades run for 2 hours resulted in 11 ruptures, whereas the blade coated with polyurethane did not result in any rupture at all.

[0024] The techniques based on the use of soft coatings on hard carrier materials is, in accordance with the present invention, not restricted to the use of only polyurethane of the types exemplified above but can also be constituted by other materials having the hardness properties which satisfy the requirements for operability with concomitant low rupture frequency and quality related to a certain production. The characterizing feature of the coating blade in accordance with the present invention is the fact that the coating is attached by vulcanization, gluing or casting on a carrier material in the form of a band of steel or other dimension-stable material meeting with the required shape and position tolerances, such as straightness, width, length and thickness. The techniques according to the present invention based on the use of soft coating materials further result in the advantage that the steel band can be bent and wound without the coating being damaged or disattached.

[0025] The present invention will in the following be exemplified by non-limiting examples in connection with the appended drawings, wherein:

5 Figures 1-3 show diagrammatically cross-sections through coating blades according to the present invention designed with varying cross-sections;
Figure 4 shows diagrammatically an apparatus according to the invention with two juxtaposed coating devices; and
Figure 5 shows a detail of the area around the two juxtaposed coating blades with associated coatings.

10 [0026] Figure 1 shows the edge section of a coating blade generally designated 1 comprising a steel band 3, a coating 5 across the edge section 7 of the steel band 3. The steel band 3 is at its outer edge provided with a chamfer 9, and the coating 5 has a corresponding chamfer 11, whereby the surface of engagement against the travelling web will be enlarged.

[0027] Figure 2 shows another embodiment of the coating 5, in this case provided with a part 15 covering the outer edge 17 of the steel band 3. Also in this case the coating 5 has a chamfer 11.

15 [0028] Finally, figure 3 shows a third embodiment of the coating blade according to the invention, where the free edge 17 of the steel band 3 is straight and uncoated. In this embodiment the coating 19 is designed with a tetrahedral cross-section, again with a chamfer 11 defining the surface of engagement against the travelling web.

[0029] In the embodiments shown in figures 1-3 certain dimensions and angles have been allotted designations. In the table below values and intervals with regard to these dimensions and angles are given. With regard to dimensions a, b, c and d the measurements are in millimeters.

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TABLE

	a	b	c	d	α	β	χ	δ
Fig. 1 Ex- emplified	0.8	2.0	2.0	-	30°	20°	5°	-
Fig. 1-2 Preferred range	0.6- 1	1- 2.5	1- 2.5	-	15°- 45°	15°- 35°	0-10°	-
Fig. 1-2 range	0.25 -2	0.5- 5	0.5- 5	-	0-60°	5°-50°	0-15°	-
Fig. 3 range	0.25 -2	-	0.5- 5	0.5- 5	0-60°	5-50°	-	0- 75°

[0030] Figure 4 shows an apparatus according to the present invention, comprising two juxtaposed blade coating devices generally designated 25,27. Each blade coating device includes a coating blade 29,31 and a blade holder 33,35 operating with movable attachment of the respective blade so that they can move against and away from the travelling web. The blades 29,31 are brought to engagement against the travelling web 41 by means of pressure ledges 37,39 actuating the blades near their free edges thereof.

[0031] The blade coating devices 25,27 which are shown only diagrammatically in figure 4 can be designed in accordance with the device described in patent application WO93/05887, and with regard to constructional details reference is made to the disclosure of said patent application.

[0032] As is further clear from figure 4 a paper web 41 is fed in a downward direction in the nip between the two coating blades 29,31. Before the nip the paper web 41 is applied on both sides thereof with a coating paste by means of diagrammatically shown applicators 43,45 which before the nip between the coating blades 29,31 form ponds 47 of coating paste.

[0033] Figure 5 shows a detail of the area around the free edges of the juxtaposed coating blades 29,31 with coatings 5 with chamfered engagement surfaces 11.

[0034] As previously indicated the invention is not restricted to the embodiments shown since changes and modifications are obvious to the skilled artisan. Thus, the invention is not restricted in other way than as is clear from the appended patent claims.

Claims

1. Coating blade for applying coating material onto a travelling web (41), particularly coating liquid onto a travelling paper web, comprising a steel band (3), which, along the edge section (7) intended to engage the web (41), is provided with a wear-resistant coating (5), **characterized in that** said coating (5) is constituted by a material which has a hardness according to Shore A of from about 10 to about 100.
2. Coating blade according to claim 1, **characterized in that** the material has a hardness of about 30 to about 80, particularly about 40 to about 70.
3. Coating blade according to claim 1 or 2, **characterized in that** said material is constituted by an organic polymer.
4. Coating blade according to claim 3, **characterized in that** the organic polymer is selected from polyurethanes, styrene-butadiene polymers and polyolephins.
5. Coating blade according to claim 4, **characterized in that** the organic polymer is a polyurethane.
6. Coating blade according to any preceding claim, **characterized in that** the steel band (3) has a thickness within the range about 0.2 to about 2 mm.
7. Coating blade according to any preceding claim, **characterized in that** the coating (5) has a thickness within the range about 0.5 to about 5 mm.
8. Coating blade according to any preceding claim, **characterized in that** the coating (5) covers said edge section (7) and is provided with a level for enlargement of the surface (11) of engagement against the web (41).
9. Coating blade according to any preceding claim, **characterized in that** the coating (5) seen in the plane of the blade (1) and perpendicular to the longitudinal direction of the blade (1) has a width of about 5 to about 25 mm.
10. Apparatus for the coating of a travelling web (41), comprising means to carry and transport the web and two opposite coating blades (29,31) extending across the web (41) and engaging same with one edge section thereof, and which at the opposite edge are arranged in a blade holder (33) for each blade with a fastening which allows movability to and fro the web (41) of said edge section (7) without essential deflection of the blade (29,31), further comprising pressure means (37,39) arranged so that each blade (29,31) by said edge section (7) is brought to engage the web (41) forwarded between the opposite coating blades (29,31), **characterized in that** both coating blades (29,31) are designed in accordance with what has been claimed in any one of claims 1 to 9.

Patentansprüche

1. Beschichtungsklinge zum Aufbringen von Überzugsmaterial auf ein sich bewegendes Band (41), insbesondere einer Beschichtungsflüssigkeit auf eine sich bewegende Papierbahn, mit einem Stahlband (3), das entlang dem Kantenabschnitt (7), der an dem Band (41) angreifen soll, mit einem verschleißbeständigen Überzug (5) versehen ist, **dadurch gekennzeichnet, daß** der Überzug (5) aus einem Material gebildet ist, das eine Härte gemäß Shore A von etwa 10 bis etwa 100 hat.
2. Beschichtungsklinge nach Anspruch 1, **dadurch gekennzeichnet, daß** das Material eine Härte von etwa 30 bis etwa 80, insbesondere etwa 40 bis etwa 70, hat.
3. Beschichtungsklinge nach Anspruch 1 oder 2, **dadurch gekennzeichnet, daß** das Material durch ein organisches Polymer gebildet ist.
4. Beschichtungsklinge nach Anspruch 3, **dadurch gekennzeichnet, daß** das organische Polymer aus Polyurethanen, Styrol-Butadien-Polymeren und Polyolephinen ausgewählt ist.
5. Beschichtungsklinge nach Anspruch 4, **dadurch gekennzeichnet, daß** das organische Polymer ein Polyurethan ist.

6. Beschichtungsklinge nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, daß** das Stahlband (3) eine Dicke in dem Bereich von etwa 0,2 bis etwa 2 mm hat.
7. Beschichtungsklinge nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, daß** der Überzug (5) eine Dicke in dem Bereich von etwa 0,5 bis etwa 5 mm hat.
8. Beschichtungsklinge nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, daß** der Überzug (5) den Kantenabschnitt (7) überdeckt und mit einer Höhe zum Vergrößern der Eingriffsfläche (11) gegen das Band (41) versehen ist.
9. Beschichtungsklinge nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, daß** der in der Ebene der Klinge (1) und senkrecht zur Längsrichtung der Klinge (1) zu sehende Überzug (5) eine Breite von etwa 5 bis etwa 25 mm hat.
10. Vorrichtung zum Beschichten eines sich bewegenden Bandes (41), mit einer Einrichtung zum Tragen und Transportieren des Bandes und zwei gegenüberliegende Beschichtungsklingen (29, 31), die sich quer zu dem Band (41) erstrecken und mit demselben mit einem Kantenabschnitt in Eingriff stehen und welche an der gegenüberliegenden Kante in einem Klingenhalter (33) für jede Klinge mit einer Befestigung angeordnet sind, die eine Bewegbarkeit des Kantenabschnittes (7) in Richtung auf das Band (41) und von diesem weg ohne wesentliche Auslenkung der Klinge (29, 31) gestattet, ferner mit einer Druckvorrichtung (37, 39), die so angeordnet ist, daß jede Klinge (29, 31) durch den Kantenabschnitt (7) mit dem Band (41) in Eingriff gebracht ist, das zwischen den gegenüberliegenden Beschichtungsklingen (29, 31) vorwärts transportiert wird, **dadurch gekennzeichnet, daß** beide Beschichtungsklingen (29, 31) so ausgestaltet sind, wie es in einem der Ansprüche 1 bis 9 beansprucht ist.

Revendications

1. **Lame de couchage destinée à appliquer une matière de couchage sur une bande en mouvement (41), en particulier un liquide de couchage sur une bande de papier en mouvement, comportant une bande d'acier (3) qui, le long de la section de bord (7) prévue pour engager la bande (41), est pourvue d'un revêtement résistant à l'usure (5), caractérisée en ce que ledit revêtement (5) est constitué par une matière qui a une dureté selon l'échelle Shore A d'environ 10 à environ 100.**
2. **Lame de couchage selon la revendication 1, caractérisée en ce que la matière a une dureté d'environ 30 à environ 80, en particulier d'environ 40 à environ 70.**
3. **Lame de couchage selon la revendication 1 ou 2, caractérisée en ce que ladite matière est constituée par un polymère organique.**
4. **Lame de couchage selon la revendication 3, caractérisée en ce que le polymère organique est choisi parmi les polyuréthanes, les polymères styrène-butadiène et les polyoléfines.**
5. **Lame de couchage selon la revendication 4, caractérisée en ce que le polymère organique est un polyuréthane.**
6. **Lame de couchage selon l'une quelconque des revendications précédentes, caractérisée en ce que la bande en acier (3) a une épaisseur dans la plage d'environ 0,2 à environ 2 mm.**
7. **Lame de couchage selon l'une quelconque des revendications précédentes, caractérisée en ce que le revêtement (5) a une épaisseur dans la plage d'environ 0,5 à environ 5 mm.**
8. **Lame de couchage selon l'une quelconque des revendications précédentes, caractérisée en ce que le revêtement (5) recouvre ladite section de bord (7) et est pourvu d'un niveau pour l'agrandissement de la surface (11) d'engagement contre la bande (41).**
9. **Lame de couchage selon l'une quelconque des revendications précédentes, caractérisée en ce que le revêtement (5) vu dans le plan de la lame (1) et perpendiculairement à la direction longitudinale de la lame (1) a une largeur d'environ 5 à 25 mm.**

10. Appareil pour le couchage d'une bande en mouvement (41), comportant des moyens destinés à supporter et transporter la bande et deux lames de couchage opposées (29, 31) s'étendant sur la bande (41) et engageant celle-ci avec une section de bord, et qui au niveau du bord opposé sont disposées dans un porte-lame (33) pour chaque lame avec une fixation qui permet une mobilité vers et à l'écart de la bande (41) de ladite section de bord (7) sans flexion essentielle de la lame (29, 31), comportant en outre des moyens de pression (37, 39) prévus de telle sorte que chaque lame (29, 31) est amenée par ladite section de bord (7) à engager la bande (41) avancée entre les lames de couchage opposées (29, 31), caractérisé en ce que les deux lames de couchage (29, 31) sont conçues selon l'une quelconque des revendications 1 à 9.

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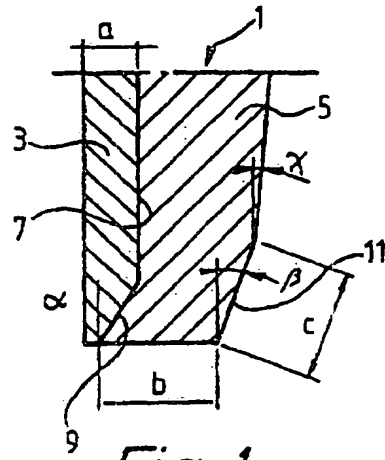


Fig. 1

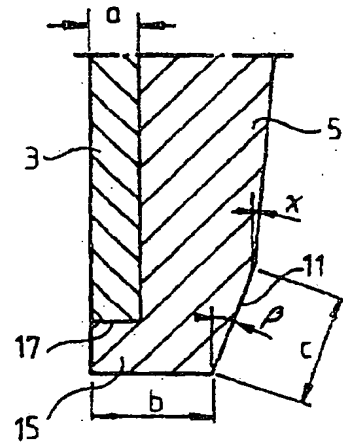


Fig. 2

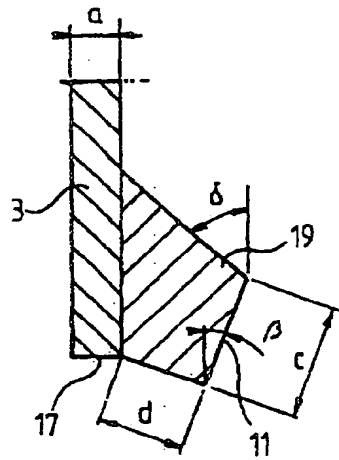


Fig. 3

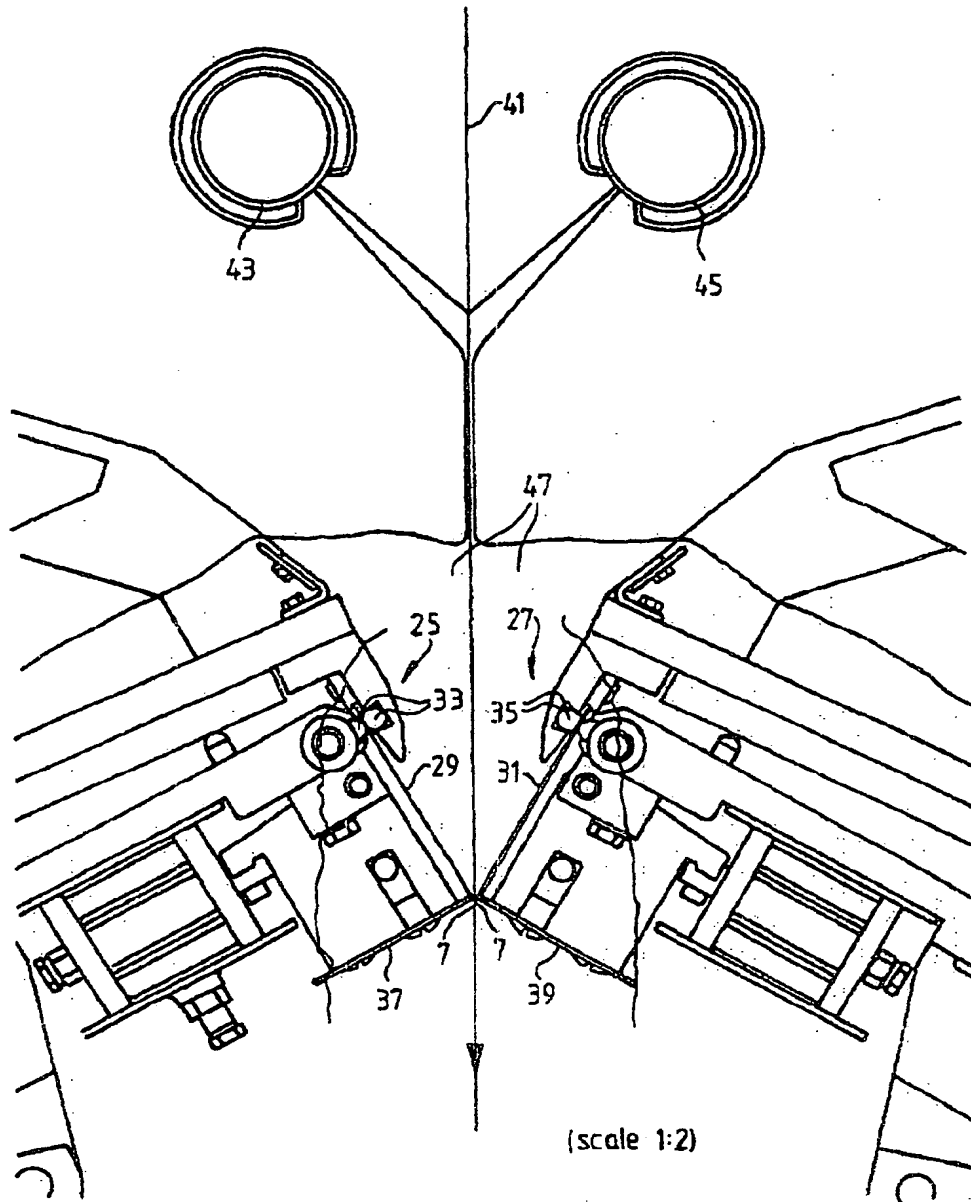


Fig. 4

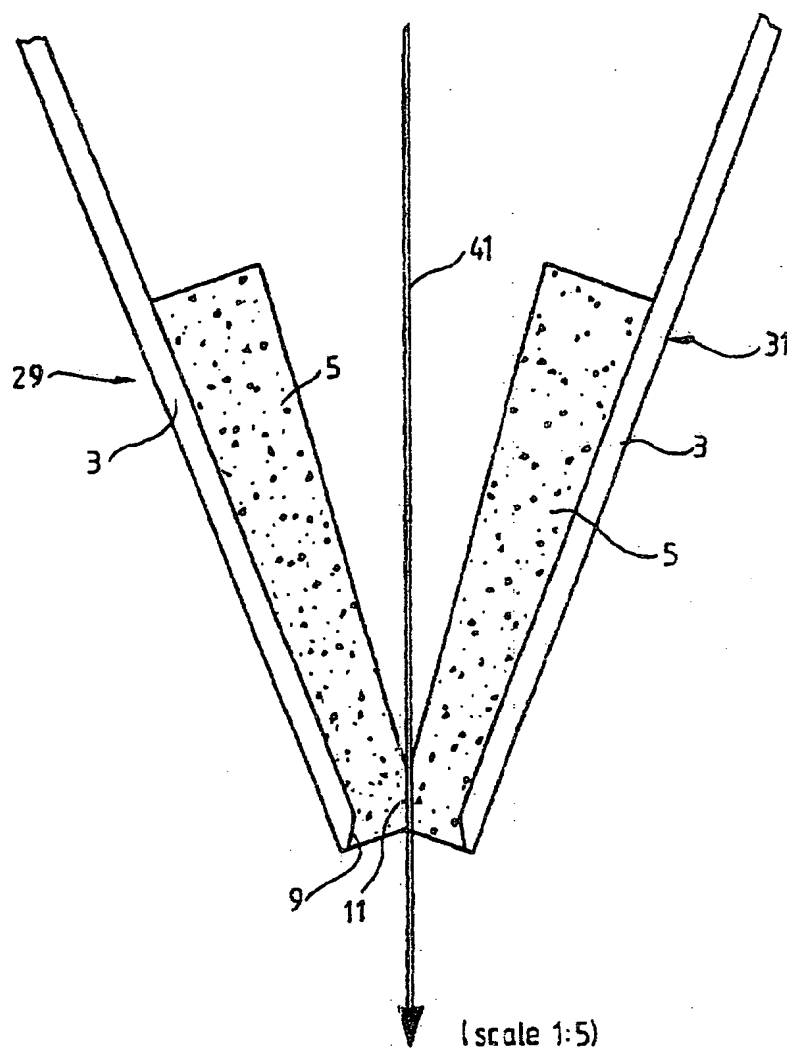


Fig. 5